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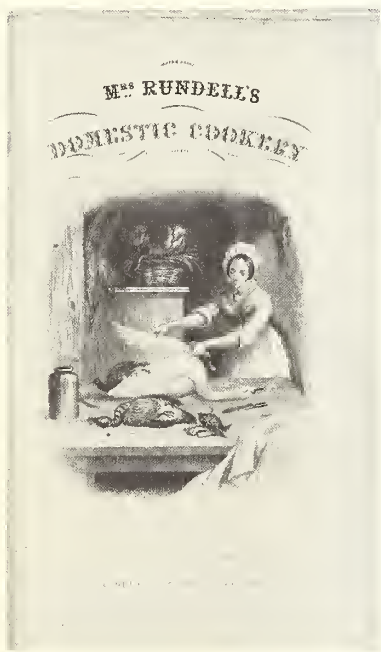

FOOD AND NUTRITION

The Associates of the National Agricultural Library, Inc. Beltsville, MD 20705

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Guest editor of this issue is Robyn Frank.

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INTRODUCTION

The World Food Conference held in Rome in 1974 made it apparent that the world food situation ranks high among the major problems that confront mankind today. This fourth Bicentennial issue of *Associates NAL, Today* is devoted to the area of food and nutrition which interests not only farmers, researchers, and health personnel, but also politicians, community groups, and the general public.

This issue focuses on selected programs in the United States that are concerned with research and information services in the area of food and nutrition. An earlier article on the Food and Nutrition Information and Educational Materials Center at the National Agricultural Library was published in *Associates NAL, Today,* Newsletter No. 13, April 1975.

The concern of these services is to make the public more aware of nutrition and the work that is being done in specific technological areas that will contribute to alleviation of this problem.

Robyn Frank
Editor

EDITORIAL REFLECTIONS

Beginnings . .

The segments of the National Agricultural Library that were to become a basic factor in the 1971 establishment of the Food and Nutrition Information and Educational Materials Center (FNIC) [1] by the Food and Nutrition Service of the United States Department of Agriculture (USDA) and the NAL had their beginning in 1919. The acquisition of printed materials and other information media relevant to food and nutrition in the formative years is a tribute to the wisdom, foresight of a dedicated library staff and cooperative efforts of the administrators of the USDA Library and the USDA Bureau of Home Economics (BHE).

The Bureau of Home Economics was created on July 1, 1923. Previous to that time, this function was performed by the USDA States Relation Service, Office of Home Economics. In 1919 personnel of the office included a bibliographical assistant under the general supervision of the Office of States Relation Services Library.

The collection of literature contained in States Relation, Office of Home Economics became the nucleus of the Bureau of Home Economics Library in July 1924. Miss Mabel A. Nye, who served as bibliographical assistant in the Office of Home Economics, was appointed the Bureau's librarian. In October 1924 the BHE was moved to one of the temporary buildings built by the Government during World War 1 as a hotel for women. This facility was some distance from the USDA Library. [2]

The distance gap made it necessary for the BHE Library to enlarge its collection of reference and bibliographical tools. During the first year of existence, the Library received a number of gifts including 121 from the *Journal of Home Economics.* Those that were not duplicates were cataloged in the USDA Library and the complete collection filed in the Bureau Library. The exact figures of holdings at the time of transfer are not readily available.

In 1924 the Library began to prepare a section of the *Meat Bibliography* which was undertaken by a committee of the Department. Material gathered by the Library for the *bibliography* included: composition and chemical analysis of meats, cooking of meat and the nutritive value of meat.

A catalog of home economics literature was established, which also included index cards to periodical materials on home economics subjects. In 1927 the BHE Library issued its Bibliographical Bulletin No. 1: Footwear, compiled by the librarian, produced in mimeographed form. Bibliographies compiled in the Library or with the cooperation of the Library, published by BHE followed quickly, including: *Selected List of Government Publications on Housing and Equipment; Selected List of Government Publications on Textiles and Clothing; Selected List of Government Publications on Food and Nutrition and Selected List of Publications on Household Refrigeration.*

With the expansion of the work of BHE the use of the Library increased; an intensive acquisition program was initiated; in 1929 the Library's holdings were estimated at 2,000 books, 323 periodicals currently received, in addition to state publications of interest to the Bureau. Subjects covered included: textiles, clothes, food, nutrition, household management and family relationships.

In 1932 the BHE Library was highly commended for giving much assistance and devoting great effort to requests from the Emergency Drought Relief Committee; White House Conference on Child Health and Protection and the President's [3] Conference on Home Building.

The death of Miss Nye was a sincere blow to the Library. The position was filled by Mrs. Eva Thayer Shively, an assistant in the USDA Bureau of Agricultural Economics Library. Mrs. Shively resigned on July 14, 1927; the vacancy was filled on August 22, 1927 by Mrs. Mamie F. Nystrom, formerly assistant librarian of the USDA Bureau of Chemistry Library. Mrs. Nystrom held this position until here retirement in 1940.

Miss Julia Merrill [4] a member of the BHE (Aunt Sammy staff) served as a librarian from the summer of 1940 until, BHE, the Bureau of Chemistry and Soil and the Bureau of Animal Industry Libraries were merged in 1942 to become the Beltsville Branch of the USDA Library.

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EFFECTS OF MODIFIED FAT DIETS ON BLOOD PRESSURE AND OTHER RISK FACTORS FOR HEART DISEASE IN MAN [1/]

by

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During the last five years, the Lipid Nutrition Laboratory (LNL), Nutrition Institute, Agricultural Research Service (ARS), under the direction of Dr. James M. Iacono has been conducting diet studies with human volunteers to learn how important risk factors such as elevated blood lipids can be reduced to lower the risk of developing heart disease. Some results of the first study have been published (1 - 4).

A major objective of the research has been to study the effects of different dietary fat levels in a real-life situation rather than in a laboratory environment. Accordingly, the studies were designed as "free-living" studies. The LNL studies are not the first of this type. They differ from previous free-living studies in one important respect. Almost every item of food the participants are given to eat is either weighed or measured.

We felt it was important to formulate diets with foods that people customarily eat. Even if low fat diets can be proved desirable from a health standpoint, it is unlikely that most people would be willing to adhere to such diets if adherence would require them to make radical adjustments in the kinds of foods they buy and eat. Therefore, all diets of our studies have included only items that are purchased every day by American consumers.

In the first study in the series (the one upon which the present report is based), only people 40 to 60 years old were accepted as volunteers because people in this age group are most affected by heart disease. Eventually, we hope to continue the series of diet studies with other age groups, including young people. What happens in the early years is important, because serious illness due to cardiovascular disease often is not a sudden event but becomes apparent only after many years of development. Diet almost certainly has an important role in this process, and the LNL research is aimed at getting some basic information on this role.

Our research is concerned primarily with the use of fat by the population as a whole rather than with development of treatments for people with cardiovascular disease. Only people in good health are accepted as volunteers in the studies, because the objective is to help healthy people stay healthy by learning more about how the body uses dietary fat and about metabolic and physiological responses to various types and levels of fat, including the essential fatty acids and their importance for optimal health. Such knowledge could make an important contribution to the national health if, for example, medical research were to show directly that eating of low fat

diets will help prevent cardiovascular disease.

HOW THE STUDY WAS CONDUCTED

The study was conducted jointly by the Lipid Nutrition Laboratory and the Georgetown University School of Medicine, Washington, D.C.

Study I -- in which 21 volunteers (10 men, 11 women), all in good health, ate precisely formulated and prepared meals -- was divided into two 40-day periods. In Period I, fats provided 25 percent of the calories in the diets. In Period II, fats provided 35 percent of the calories. (The percentage of calories provided by fats in typical American diets is between 40 and 45 percent.) The main difference between Period I and Period II diets was that when fats provided 35 percent of the calories, foods consumed included whole egg, bacon, sausage, half-and-half cream for coffee, whole milk and butter. All of these items were excluded from the 25 percent fat-calorie diets, except that two percent milk was allowed and eggs were allowed in recipes in amounts equivalent to about two-three eggs per week.

Each of the 21 volunteers received the number of calories required to maintain the initial body weight, and calorie adjustments were made as necessary to correct weight gain or loss. Calorie content of individual diets ranged from 1,600 to 3,600. In going from the 25 to the 35 percent fat-calorie diets, calorie intake from carbohydrates was reduced from 60 to 50 percent. Protein provided 15 percent of the calories in both periods. In addition, the amount of cholesterol in the diets with either fat level averaged about 300 mg or less per day. Normal cholesterol consumption in typical American diets often reaches levels of 600-800 mg per day.

In formulating the diets, we attempted to achieve a 1:1 ratio of polyunsaturated to saturated fats (1:1 P/S ratio). This meant that when sausage and other sources of saturated fats were added in the shift from Period I to Period II diets, salad oil or margarine or other sources of polyunsaturated fats were added to maintain the 1:1 ratio.

Five days a week, the 21 volunteers, 17 of whom were USDA employees including 10 ARS research scientists, came to a dining room at the National Agricultural Research Center in Beltsville, Maryland, for their meals. Their weekend meals were packaged and given to them on Friday, along with instructions for preparation. Other than eating the meals volunteers were asked to comply with one special request: no alcohol. Alcohol is a rich source of calories, and consumption of even small amounts could have upset the validity of the data.

In addition to studying effects of the diets on changes in blood pressure, blood coagulability and blood lipids, we studied correlations between these important risk factors and other blood constituents such as lipoproteins, glucose and urea nitrogen.

BLOOD LIPIDS AND LIPOPROTEINS

Cholesterol levels, as expected, dropped soon after the volunteers were given the 25 percent fat-calorie diets. Within 10 days, the average cholesterol level dropped about 15 percent, and did not change significantly during the rest of the study. When the volunteers were given a checkup, 33 days after the study ended, cholesterol levels had returned to pre-study levels.

On the other hand, triglyceride levels, which are usually high when high saturated fat diets are eaten, tended to rise temporarily after the 25 percent fat-calorie diets. They returned to pre-study levels when the volunteers were given the 35 percent fat-calorie diets.

Blood lipoproteins, which carry the various blood lipids in the blood stream, varied also. The pre-beta lipoproteins, which carry the triglycerides predominantly, rose when the triglyceride levels rose and fell to about pre-study levels after the period II diets.

PLATELET AGGREGATION

Coagulability of the blood -- its tendency to form clots -- is involved in a common cardiovascular problem known as thrombosis. Thrombosis is defined as the formation of thrombus (coagulated blood, or clot) that plugs a blood vessel or a cavity of the heart. Clotting is a complex process involving blood platelets and many other substances. In the formation of clots within the blood, the clotting process involves collagen, a fibrous protein that is present in blood vessels, skin and other organs. Another substance important in the clotting process is thrombin, an enzyme that catalyzes clotting of blood.

Laboratory analyses of blood samples from volunteers in the study showed that the low fat diet had pronounced effects on three factors important in coagulability: platelet count, response to collagen and response to thrombin.

Two of the standard tests in analyzing blood platelets for aggregation are to place collagen or thrombin in samples, and

note platelet response to these clot-stimulating agents. At the end of Period I, average response to thrombin was 40 percent lower than at the beginning of the test, and response to collagen was about 58 percent lower. These results indicated that the low fat diets reduced the tendency of platelets to aggregate.

During Period I, average platelet count of the men increased by more than 23 percent and of women, by more than 44 percent. During Period II, platelet counts continued to increase slightly in men (about 4 percent), but decreased in women by 21 percent.

BLOOD PRESSURE

Blood pressure is one of the important risk factors in cardiovascular disease. Therefore, the changes we observed in blood pressure after changing the fat level in the diet from pre-study levels of 42 percent and a P/S ratio of 1:3 were considered to be very important.

Some volunteers in the study had blood pressures in the high range for their ages. The average for the males at the beginning of the test was 145 (systolic) and 85 (diastolic) or 145/85 mm Hg. The average was 125/75 at the end of Period I (the first 40-day period during which fats furnished 25 percent of the calories in the diet). The average for the females was 129/76 at the beginning of the study and 121/71 at the end of Period I. There were virtually no changes in blood pressure during the next 40-day period, in which fats furnished 35 percent of the calories. During Period II average blood pressure for men was 125/79. Average for women was 123/73. When volunteers were given their final physical examination, 33 days after the end of the study, blood pressures were almost back to pre-study levels. The changes in blood pressure coincided with the changes in plasma cholesterol when the 25 percent fat-calorie diet was fed with its low saturated fat and cholesterol contents and P/S ratio of 1:1. Also, while eating the 25 percent fat-calorie diet the volunteers ate a level of linoleic acid (the essential fatty acid) twice the amount usually eaten in normal diets. It is quite possible that the lowering of elevated blood pressure could have resulted from a combination of these factors.

The effects of other food components included in higher than usual amounts in the low fat diets remain to be evaluated, such as vitamins, minerals and fiber. There are reports of a lowering of blood cholesterol when the diet contains large amounts of fiber (5).

Since low fat diets contain larger amounts of fruits, vegetables and cereal grains than the average American high fat this factor must be considered.

Diets high in fruits and vegetables have been recommended to promote weight loss. Although weight loss was not permitted in our study, we observed that more calories were needed to maintain the body weights of our participants during the study when low fat diets were consumed than had been needed prior to the study when typical American diets had been consumed.

Prostaglandins -- a relatively new class of compounds and originally described as hormone-like--have attracted a vast amount of research activity in recent years. Prostaglandins appear to be involved in many important physiological functions in the body such as reproduction, inflamatory disease, platelet aggregation and blood pressure regulation. The prostaglandins are really fatty acids that are made in the body from the essential fatty acids.

Some reports showed that prostaglandins given intravenously to human subjects caused a marked drop in blood pressure of hypertensives (those whose blood pressure was higher than 160/90 mm Hg). The drop in blood pressure was accompanied by a rise in urine output and in the excretion of sodium. Patients treated with prostaglandins also had a rise in prostaglandin output in the urine (6, 7).

Since the prostaglandins are products of essential fatty acid metabolism, studies of this kind suggest that the fall in blood pressure of the participants in our study may have been caused by the doubling of the linoleic acid consumption when the low fat diets were given.

Although it is known that high salt intake may contribute to elevated blood pressure in some individuals, salt consumption was ruled out as a factor in our study.

In the second study of our human diet series, similar reduction in elevated blood pressure was observed. Recommendations can be made for the general population to consume diets low in saturated fat to reduce the danger of thrombosis, the level of blood cholesterol *and* elevated blood pressure only after further confirmation of these results.

1/ Researchers at Beltsville who participated in the study in addition to Dr. Iacono (now ARS Deputy Assistant Administrator) and the author were Dr. Norberta Schoene, Ms. Rita Dougherty, Ms. Marcia Wheeler, Mrs. Patricia Leapley,
(Continued on page 11)

UNDER–UTILIZED SOURCES OF HIGH QUALITY PROTEIN

by
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> Yet among the winged insects that go on all fours you may eat those which have legs above their feet, with which to leap upon the earth. Of them you may eat; the locust according to its kind, the bald locust according to its kind, the cricket according to its kind, and the grasshopper according to its kind. *Leviticus 11:21–22.*

Where a significant portion of food is still obtained by hunting and gathering, we frequently find rituals and ceremonies designed to ensure the supply of certain desirable plants or animals. Often these are insects.

People raised in western cultures usually react with shock and disgust at the mere suggestion of consuming insects. Yet when we examine the idea objectively, what is there to repel us so strongly? Many insects consume only the cleanest food supply. Often it is one which we cannot exploit directly or perhaps even indirectly. We consume the whole animal in the case of oysters and clams, so this should not deter us. We consider the closely related shrimps, lobsters and crabs as delicacies. Most importantly, the sparse information we have on the composition of insects compares very favorably with the protein content of our more usual sources. They are available almost universally. Why do we not accept them?

Where European cultures have not dominated habits and preferences with regard to food, nearly all major insect families in all stages of development are represented in the diet of some group of people. In many cases the quantity of protein and calories in the form of fat obtained from this source is significant. Locusts (grasshoppers) and termites seem to provide the largest quantity largely because of their availability. Certain species occur in major outbreaks and are locally important, such as various species of flies breeding in alkaline or fresh water lakes, a species of moth in Australia, and social insects of many kinds. Large species of water bugs, palm worms and various beetles are searched out as delicacies.

How do they compare to more conventional foods? The fresh composition of some of the major food insects varies between 10 and 27 percent protein. Medium fat beef is about 17 percent protein, fish fillets average around 21 percent, and medium fat pork is about 12 percent. The fat content is more variable but most insects are between three and eight percent with locusts at 21 percent and termites 28 percent. Fish averages about three

percent, medium fat beef 22 percent and medium fat pork 40 percent. Very little information is available on vitamin and mineral contents, but some species seem to be rich sources of one or more of these nutrients.

Only a few cases of adverse effects have been reported from eating insects. A few species seem to cause acute gastrointestinal reactions when they first occur but the natives continue to eat them and quickly recover. The caterpillars of an Anaphe species in Africa appear to cause fairly severe individual reactions but others eat them with impunity. In Japan, all pupae living in the ground other than wasps are avoided. The most serious, sometimes fatal, complication is caused by overconsumption when the swarms first appear. This is intestinal impaction caused by the accumulation of indigestible skeletons.

Assuming insects could be a nutritious addition to our food supply, what should our course of action be? Our ignorance is so abysmal that almost any research project that could be suggested would add to our knowledge. Many of the species consumed by native tribes have not been properly identified and described. We have done no work to help the small landholder increase the supply of an insect he and his family consume when available. Food technology and food preparation directions are almost totally absent. Nutrient information is sparce. Availability studies are nearly non-existent. Possible adverse effects have not been investigated. With the prodigious reproductive capability of many insects, mass production is obviously possible but never investigated. The possibility of disposing of some of our wastes in this way and feeding the resulting protein and fat to more acceptable animals is an obvious possibility. Processing the nutrients into prepared dishes or into materials that could be incorporated into other foods would probably be a simple adaptation of existing technology.

Another class of invertebrate, already in limited commercial production, that would be useful in disposing of wastes, improving the soil, and furnishing useful protein and calories for animal feeds is the earthworm. Large quantities of manure, garbage, and cellulosic waste could be reduced manyfold by feeding to earthworms in already developed culture methods. Again, a great deal of research is needed on culture of additional species and the use of earthworms in reclaiming and improving agricultural land.

With the shortage of protein and calories in the world today it is time we begin to seriously consider exploiting these unbiquitous animals that seem to resist all our efforts to destroy them. At least some of them can be put to use.

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Thoroughly covers the reports of insect usage through 1950. Little new work has appeared since.

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(Continued from page 20)

for reducing costs as well as increasing the food supply. It also may indicate that the developed countries have substantial food losses too, but they occur at a different place in the food system.

Losses at the consumer level could be due to improper buying habits, improper home storage, poor food preparation, over serving, or similar factors. These could be approached by improved consumer food education.

Many times that product which appeared good on the supermarket shelf may not be what was represented on the label, be lacking in taste or flavor, have internal damage or have so little remaining shelf life it broke down immediately in the home. In these cases, the accountability for the cause of the loss lies somewhere back up the marketing chain.

It may be we have learned just enough about product preservation to be able to pass our problems on to the consumer. In the United States the major farm loss in foods does appear to be at the consumer level and we should make a major effort to examine and correct the various causes of those losses.

NUTRITION EDUCATION IN A CHANGING WORLD

by
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"Nutrition education" may become a household term. Several events during the last ten years raised the consciousness of the United States population to the need for improved nutrition education in our country. Government, industry, and academia are responding with increased efforts to meet this need, particularly for children of school age.

In early 1975, the School Nutrition Education Curriculum Study was initiated and work was begun to design a comprehensive nutrition curriculum for schools and community. A team of nutritionists and educators at the Pennsylvania State University was charged to encourage and support efforts to introduce nutrition education into public school curricula. This endeavor is one component of a larger nutrition education project made possible by a grant from the Heinz Endowment, given through the Nutrition Foundation.

This curriculum, "Nutrition Education in a Changing World," addresses the increasing concern that nutrition education be improved and expanded within the state and nation. It includes up-to-date scientific information, stresses proper attitudes toward the nutrition-health relationship, is sensitive to the nutrition issues confronting our world, presents a personalized consumer orientation, and encourages skills in use of resources. Furthermore, it recognizes the needs and interests of learners; the concerns of teachers, parents and community; the requirements of schooling; and the goals of education in the state.

A PURPOSE AND AN ULTIMATE GOAL:

The overall purpose of this interdisciplinary project is to provide children and youth with knowledge, skills, and attitutdes to promote nutritional health throughout a lifetime. The ultimate goal is to produce nutritionally literate decision-makers . . . motivated, knowledgeable, skilled, and prepared to make wise decisions concerning nutrition for themselves, and perhaps for others as well, in a changing world. A nutritionally literate decision-maker is one who both desires good health and is willing to consider and choose proper nutrition alternatives.

In order to proceed with its mission, The School Nutrition Education Curriculum Committee outlined three major tasks:

1. Development of a classroom-tested, comprehensive nutrition curriculum,

2. Design of a "change model" of linkages, collaboration, and field support services for the effective dissemination of a nutrition education curriculum,

   and

3. Assessment of local needs and evaluation of the project processes and the outcomes.

CURRICULUM DESIGN:

The curriculum design is a systematic plan whereby nutrition principles and practices are given attention throughout schooling in ways that are appropriate to the developmental level and interests of the learners. "Curriculum design" is not meant in the narrow sense to be the preparation of a set of prescribed materials on which a program must depend.

"Nutrition Education in a Changing World" is designed upon a comprehensive core of basic nutrition concepts, skills, and commitments. These fundamentals of nutritional health care, when presented in a systematic, integrated way, and spiraled through the existing school curricula should provide the bases upon which to build attitudes, knowledge, and abilities needed by a high school graduate to function as a nutritionally literate adult.

Another important part of the curriculum is a set of total Program Goals, identified for learners. These Program Goals provide focus and direction for units, lesson objectives, and activities. In this manner, the curriculum establishes a vertical continuity between the nutrition learning experiences offered in a broadening way, grades N-12/Adult.

A set of units and lessons has been written for grades 4–6 as an example to show how nutrition principles might be taught in coordination with other subjects, how different learning styles might be accommodated, how recommended nutrition education materials from other sources might be used effectively, etc. These units, after field-testing and revision, are intended to serve as a "starter set" of lessons for teachers to use. In the future, the training in nutrition alongside education-methods courses should enhance confidence teachers feel so that they eventually may design their own nutrition lessons, learning activities, and evaluation plans.

Initial development of these lesson materials was begun with the grades 4–6 segment because this is the stage at which youngsters can deal with a simple constellation of ideas and integrate those ideas with understanding. It is also possible to test children more readily at this stage, rather than earlier, since reading as a basic skill has been learned. The nutrition curriculum for grades 4–6 includes three units which are essential to the comprehensive coverage of nutrition fundamentals; seven more units may be used optionally. The use of the optional units will depend on such factors as a needs assessment for a given class or school situtation, the amount of class time available, and the commitment of the teaching staff.

A nutrition curriculum for the preschool through third grade is now being developed. It stimulates an awareness of nutrition and its importance, along with a beginning vocabulary in preparation for the grades 4–6 nutrition program. More complex issues relating to nutrition will be introduced later in units and lessons, correlated with established subjects where appropriate for grades 7–12.

A CHANGE MODEL:

Concurrent with curriculum development, the School Nutrition Education Curriculum Committee is studying various approaches through which a nutrition program can be introduced, implemented, maintained, and supported in a school. An effective change model should evoke commitment to and involvement with nutrition education in schools by school administrators, teachers, school service personnel, local community resources, parents, and the community at large. Also important is the maintenance of communication and rapport between the curriculum project staff and key people in the state department of education, state health department, legislature, government at all levels, special resource people, and professional organizations which claim a special interest in nutrition education.

Teacher-training in nutrition subject matter and various methods to teach nutrition is considered an essential part of the project's change model. The first nutrition education courses for inservice and preservice teachers and school service personnel were held in the summers of 1975 and 1976 at the Pennsylvania State University. These courses were taught by teams of nutritionists and education specialists. Graduate students in nutrition and education served as assistants for these courses, making more staff time available for individualized instruction. The students of these classes studied nutrition and curriculum development, and prepared nutrition units and activities to be used in their school or community settings.

During the periods when the teachers presented their nutrition units they were visited by members of the Nutrition Curriculum Study Committee. The problems and questions the teachers themselves presented were referred to the staff at the Nutrition Information and

Resource Center at the University. In this way teachers in the field received encouragement when needed. They also received information on how to identify recommended references, access nutrition education print and nonprint materials, contact various professionals as resource people, and use community resources.

Schools need help in establishing nutrition education programs, especially at the primary-elementary levels where nutrition falls outside the traditional subjects. In support of schools attempting to implement a nutrition program, the School Nutrition Education Curriculum Committee accepts invitations to provide introductory programs, inservice nutrition education workshops, consultation with staff, and assistance in the preparatioh of grant proposals for nutrition education programs.

EVALUATION:

The Evaluation Team has been responsible for the assessment of the Nutrition Education Curriculum Project's efforts in terms of products, processes (in so far as possible), and outcomes for learners. Evaluation of each component contributing to the total curriculum development is considered essential in order to modify effectively the materials, approaches, etc.

The Evaluation Team designed a total needs assessment package to determine the need and the focus for nutrition education in a given school or community, and to identify available resources. This team pretested and posttested teachers and school service personnel who took the summer nutrition education workshops to evaluate the impact of training in nutrition.

Another unique contribution has been the determination of priorities for Total Program Goals for high school graduates who have been trained adequately in nutrition. This was accomplished through a survey of one thousand members of the Society for Nutrition Education. This was the first time a professional body of nutrition educators was tapped for its collective input to the design of a comprehensive curriculum for schools.

The above has been a brief description of a curriculum, "Nutrition Education in a Changing World," now being developed. The project committee is working to create an innovative, integrated, N-12/Adult nutrition program for schools which can be extended to parents and community. Every attempt will be made to share news of progress in this endeavor with those in allied areas who share a concern for nutrition education in today's world.

* * * *

(Continued from page 6)

Ms. Wilma Ross, Ms. Vestine Washington, Calvert Young, David West and James Church, Lipid Nutrition Laboratory; Ms. Carol Waller, Nurse, BARC; Dr. James Mackin, Dr. Richard Binder and Ms. Judy Jenks, Georgetown University Medical School.

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USDA TABLES OF FOOD COMPOSITION
HISTORY AND PROGRESS

by
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When W. O. Atwater initiated his research in human nutrition in the latter part of the 1800's, the chemical composition of American foods was an integral part of the investigations. In the annual report of 1892 on their work at the Connecticut (Storrs) Agricultural Experiment Station, Atwater and his associate, C. D. Woods, included tabulations of preliminary data on a wide range of foods to provide the information needed for evaluating the diets they were studying. [1]

Four years later, in 1896, a booklet, "The Chemical Composition of American Food Materials," was published. It was by Atwater and Woods and was issued as *Bulletin* No. 28 of the Office of Experiment Stations, U. S. Department of Agriculture. [2] This classic document was the first comprehensive table of food composition in this country and marked the beginning of a long series of food tables prepared and issued by research staff of the Department of Agriculture.

Of the nearly 2,600 analyses of American foods used for this first major food table, most had been carried out under the direction of Atwater or his collaborators in several eastern and mid-western states and in the Division of Chemistry of the U.S. Department of Agriculture. Edible portions of foods were analyzed for their proximate composition – that is – for their content of nitrogenous matter expressed as protein total lipid expressed as fat, volatile matter expressed as water, and ash. Carbohydrate content was calculated as the difference between the sum of the percentages of these determined components and 100. Data were obtained also for the percentage of any inedible parts of the product analyzed.

Using information on the proximate composition of foods, Atwater, with other scientists, developed and tested a method for measuring the physiologic energy value of foods. They expressed these energy values in calories. The ingenious research of these nutrition pioneers in measuring energy requirements of the human body and energy values to the body of food eaten was the subject of numerous scientific writings and was explained by Atwater and Bryant in 1899 in the 12th *Annual Report* of the Connecticut (Storrs) Agricultural Experiment Station. [3] The same year Atwater and Bryant issued a revised and much expanded edition of *Bulletin* No. 28 and in 1906 a second revised edition. [4, 5]

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*The author gratefully acknowledges the advice of Dr. Bernice K. Watt, Former Group Leader, Nutrient Data Research Group, (retired) and Miss M. Louise Orr, Nutrition Analyst, Nutrient Data Research Group.

During the early 1900's the need for greater knowledge about human nutrition continued slowly to gain recognition, and with it the need for improved data on the composition of foods. For years *Bulletin* No. 28 served admirably as the source of data on composition and energy value of foods. It was used by students of nutrition in the prestigious centers of research and education and information from it was reprinted in early text books and in manuals of dietetics.

The number of samples of any one kind of food analyzed and the maximum, minimum, and average values found for each of the components determined had been reported in *Bulletin* No. 28. The data in the revised editions were based on over 4,000 specimens of American foods. Even so, the data had certain limitations. Figures that were averages had included all of the analyses available in 1899. Large numbers of samples of a few foods had been analyzed. For example, 111 samples of patent flour had been analyzed, 103 of bread, 136 of potatoes, 95 of sweetpotatoes, and 328 of sugar, including brown and coffee sugar. However, for dozens of other foods fewer than five to ten samples had been analyzed, and very often only one or two samples.

By the early 1920's data that were more precise and that could be applied to foods then in use in this country were needed. Under the direction of Charlotte Chatfield, an intensive effort was made to bring together from the literature and unpublished sources all available data that could be used in developing tables of food values for American foods.

The foods were studied by groups. The first of these studies to be published was on meat. It was USDA *Circular* 389, "Proximate Composition of Beef," and was issued in 1926. [6] It provided information on sides of beef and comparable untrimmed wholesale cuts for beef carcasses of each of four classes–thin, medium fat, fat, and very fat. The data included percentages of bone and visible fat for the sides and wholesale cuts of each class as well as the proximate composition and calorie value of the edible portion for each. The data had been developed statistically and preserved the appropriate relationships in composition among cuts within the average carcass of each class. Dietary calculations made with figures derived in this way were considered more accurate than if made using simple averages of data available.

A second study, one devoted to fresh fruits, was issued in 1928, USDA *Circular* 50, "Proximate Composition of Fresh Fruits," by Chatfield and McLaughlin. [7] Data developed from a study on vegetables were published in 1931, USDA *Circular* 146, "Proximate Composition of Fresh Vegetables." [8]

To meet the urgent need for a new comprehensive document to replace *Bulletin* No. 28, USDA *Circular* 549, "Proximate Composition of American Food Materials," by Chatfield and Adams, with data for 1,633 food items, was issued in 1940. [9] This new publication included figures with some up-dating from the studies of the three food groups that had been published earlier, and new data that had been developed for foods in many other groups. Data for fiber, a constituent of carbohydrate, as well as data for total carbohydrate were shown.

The food energy values in the new tables were calculated from data on the proximate compostion of the foods, according to the method of Atwater. Calorie factors, 4, 9, 4 calories per gram of protein, fat, and carbohydrate, respectively, that Atwater had found suitable for the total amounts of these nutrients in customary mixed diets in this country were applied to data on the proximate compostion of the individual foods.

As the scope of nutrition research expanded and the importance of individual minerals and vitamins became recognized, data for proximate composition and energy values were insufficient. The urgency for a new food table with data for additional nutrients was made more acute by World War II. The armed forces needed the data. Civilian groups also needed more complete data on nutritive values of foods. Local and national agencies responsible for rationing food supplies, fertilizer, and tin for canning, and groups determining essential food industries were among those requesting information on food values.

To assist in meeting crises arising from the emergency, the USDA in cooperation with the National Research Council prepared in mimeographed form tables of food values that included data for water content, food energy values, and data for 11 nutrients–protein, fat, carbohydrate, calcium, phosphorus, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid. The data for these nutrients were assembled by USDA staff under Bernice K. Watt from several sources: *Circular* 549, the long-established food composition files in the Department of Agriculture, and current literature. These sources were supplemented by data solicited and received in unpublished form by the National Research Council

through the work of its Committee on Food Composition. As data were sparse for the three mineral elements and five vitamins needed for these new tables, it was necessary to greatly reduce the number of foods from the extensive listings that had been in *Bulletin* No. 28 and *Circular* 549.

A number of Army ration components were included in the new tabulations, as well as a few new foods, notably enriched and restored cereal products. During the war years these mimeographed tables were revised several times to incorporate new data as they became available and to make other changes as needed.

In 1945 the data on food composition that had been found useful during the wars were published as USDA *Miscellaneous Publication* 572, "Tables of Food Composition in Terms of Eleven Nutrients." [10] A total of 275 food items were included. Data were presented in two tables, one in terms of 100 grams of edible portion, and the other in terms of one pound of food including the weight of any inedible portion or refuse present.

During and following the war, questions of assessing the calorie value of foods were revised. The Atwater procedure used in this country differed in several respects from the procedure used in Great Britain and the calorie values for the same food calculated by the two procedures often did not agree. These differences in calorie values became important to individuals in stricken areas where food was very short and supplies were allocated on a calorie basis.

An international *ad hoc* committee was convened in Washington, D.C., in February 1946 by the Food and Agriculture Organization of the United Nations to investigate the matter of comparability of data for international use. In the light of knowledge at that time, the Committee recommended the Atwater procedure, if properly used. The Committee, however, pointed out the inaccuracy of applying the general calorie factors to data on the chemical composition of individual foods. [11]

Meanwhile, Annabel L. Merrill and Bernice K. Watt of the U.S. Department of Agriculture had been making an in-depth study of the Atwater procedure. Convinced of its soundness and current practicality, they began searching the literature for data on human metabolism studies made since Atwater's time to find data for revising and extending the calorie factors Atwater had developed. A resume of their study of Atwater's work and the basis of the revised calorie factors they developed was published in 1955. [12] After 1945 the general calorie factors, 4, 9, 4 calories per gram for protein, fat, and carbohydrate, respectively, were no longer used in calculating the energy value of foods for tables of food composition issued by the USDA.

In 1950 a new link in the chain of USDA publications on the composition of foods was issued,–*Agriculture Handbook* No. 8, "Composition of foods, raw, processed, prepared," by B. K. Watt, A. L. Merrill, M. L. Orr, W. T. Wu, and R. K. Pecot. [13] It had data for water content, energy values, and the same eleven nutrients as in *Miscellaneous Publication* No. 572 issued five years earlier; also data for fiber as well as total carbohydrates. The data in this new publication were provided on three bases–100 grams of edible portion, 1 pound of food as purchased, and in terms of common household units.

The *Handbook* supplied data for 751 food items, almost three times the number in the preceding food tables. This did not, however, represent a simple addition of new food items to the previous list. Whereas in each of the former tables most of the foods for which data were provided were in the raw form or had undergone relatively simple forms of processing that were not destructive to the proximate components, foods as commonly used in the 1940's were becoming very much more complex. Some were being frozen. Many were undergoing other forms of processing before they entered the retail market and a variety of food mixtures appearing in the markets. Questions were being raised on the effects of the various kinds of processing and home preparation on nutritive values, especially on vitamin values.

Many steps had been taken in developing data for the *Handbook* to provide figures applicable to foods as used. The scientific literature and the available unpublished data had been carefully reviewed for all bits of information that would relate to chemical changes occurring between harvest or slaughter and the time when the commodity was offered on the retail market, or in some cases, ready-to-eat. Data reported from various sources, compiled, and summarized for any one food product were studied in comparison with other forms of the food to determine reasonableness of the values. When possible, factors were developed for retention of nutrients subject to loss from storage, heating, solubility, or other conditions. For some foods no analyses could be found for the product then in use. In these circumstances for an

important item, such as commercial white bread, figures were developed from the best information available. Scientists in the food industry and research laboratories of universities and government agencies were consulted on many problems arising in the interpretation of data or the derivation of values to represent foods that were then in common use. Even so, many questions remained unanswered in 1950 when *Handbook* No. 8 was first issued. Work was begun immediately toward improving the foundations for future tables of food composition and for expanding the scope of the tables to include more nutrients.

Special attention was given to certain aspects—mineral and vitamin content, including some less well-known vitamins; amino acid content; energy values; cooked, canned, and frozen food products; improved procedures for assessing nutritive values of meats, including cooked forms; cholesterol and fatty acid content; and updated figures on weight losses and yields of food products. Results of some of these studies were issued in separate publications. [14-18]

The revised edition of *Agriculture Handbook* No. 8, dated 1963, had data for 2,483 food items for the same nutrients as in the 1950 edition, plus sodium and potassium. [19] In addition, the new *Handbook* provided data for selected fatty acids, cholesterol, and magnesium on lesser numbers of food items in three shorter tables. Further information was provided in footnotes on numerous items in the tables to allow the reader to adjust the published values to apply to related items not listed.

The table on common household units that had been included in the 1950 edition of the *Handbook* was not issued as part of the 1963 edition as up-to-date figures on weights of volume measures were needed, and for many foods, had to be determined. The data from *Handbook* No. 8, with some updating, were issued for the common units of measurement as a separate publication--*Agriculture Handbook* No. 456, "Nutritive Value of American Foods in Common Units," by Catherine F. Adams in 1975. [20] In the interim, studies in special areas have continued in preparation to further update and expand the USDA standard reference materials on the composition of foods.

In 1969, *Home Economics Research Report* 36, "Pantothenic Acid, Vitamin B_6, and Vitamin B_{12} in Foods," was issued. [21] Values for 723 food items were given in terms of 100 grams edible portion and for 1 pound of food as purchased. A second table in this report listed the information available on the percentage distribution of pyridoxine (pyridoxol), pyridoxal, and pyridoxamine in foods. Separate tables on the content of cholesterol, potassium, zinc, folacin, and fatty acids in foods were published or recently submitted for publication. [22, 23, 24, 25, 26-39] An extensive revised and expanded *Agriculture Handbook* No. 102, "Food Yields Summarized by Different Stages of Preparation," published in 1975, will serve as the principal source for refuse values in the upcoming sections of *Handbook* No. 8. [40]

To meet the need for revision and expansion of food composition tables on a current basis, the USDA, under the leadership of R. L. Rizek, established a computerized Nutrient Data Bank for storage and retrieval of nutrient data and other items related to foods. This new system is presently being used in a revision of *Agriculture Handbook* No. 8. The values for each food will be printed on one page with an assigned item number and date.

Nutrient values include proximate components, 7 minerals, 9 vitamins, 19 fatty acids, cholesterol, phytosterols, and 18 amino acids and are given for 100 grams of edible portion. Standard error and number of samples are also listed, as well as values in terms of 2 common measures and 1 pound of food as purchased. Food energy is given as kilocalories and as kilojoules, and vitamin A is expressed as retinol equivalents and international units.

The new *Handbook* will be published in sections, and each section will include one or more food groups. The first two sections, *Agricultural Handbook* 8-1, "Dairy and Egg Products," and *Agricultural Handbook* 8-2, "Spices and Herbs," are available February 1977. When all sections are off the press, and the computerized data bank is operating at full scale, expansion of nutrients, numbers of foods in each of the food groups, and revision of single pages will be possible. This speculation seems to agree with the early words of Atwater in 1896, when he stated in *Bulletin* 28, "This table is intended to replace previous ones and to serve as a standard reference until it shall in turn be replaced by a larger and more complete compilation."

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(Continued from page 3)

The Beltsville Branch Library was absorbed by the new NAL facility in Beltsville in 1969.

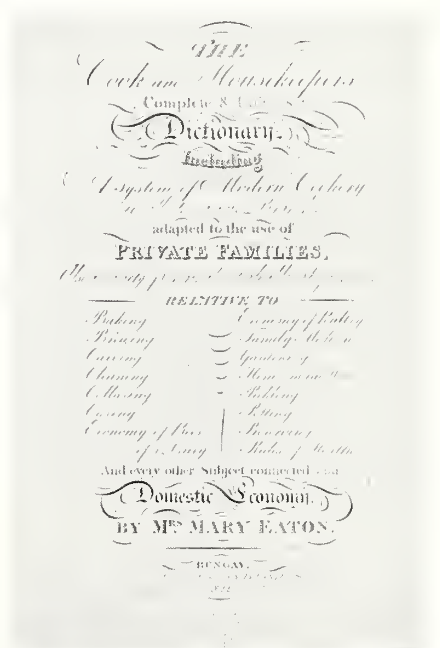
– *Angeline J. Carabelli, Editor-in-Chief*

1/ For an excellent summary of this project, see: Frank, Robyn (Technical Information Specialist, NAL) Specialized Information Service at NAL. In: *Associates of the National Agricultural Library Newsletter No. 13*, pp. 2-3, April 1975.

2/ It is interesting to note that BHE Library survived four moves during 1924-1932.

3/ Herbert Hoover 31st President.

4/ See *Associates of NAL Today*, of vol. 1, no. 1/2, pp. 7-9, January/March 1976.



Dictionary

adapted to the use of

PRIVATE FAMILIES,

RELATIVE TO

And every other Subject connected

Domestic Economy.

BY MRS MARY EATON.

Courtesy, National Agricultural Library

THE NATION'S FOOD SYSTEM

by
Dale L. Anderson
National Program Staff (MNES)
Agricultural Research Service, USDA

The United States food system is much more than our farms. In addition to the large amount of economic resources used by farmers, there are additions of labor and materials at each stage of the marketing system. A total model of the United States food system is not easy to put together as most of the available writings deal only with parts or pieces. The model developed here (Fig. 1) contains a number of approximations since the required data is either weak or non-existent. The data used is the best available from both government and industry sources and draws heavily on the USDA Economic Research Service (ERS) input-output materials. The illustration shows 1975 data in billions of dollars measured by the top to bottom width of the chart (Fig. 1). The chart shows $92 billion of farm sales with farm inputs of $20 billion, mostly feed, seed and livestock purchased from other farmers. 1/ Nonfarm inputs of $55 billion include fuel, machinery, fertilizer and similar products from nonagricultural sources produced by industry or mining. Value added consists primarily of labor and capital inputs. Other farm income includes hiring out for contract farming services and similar income sources. It is difficult to place a dollar value on other attributes of agriculture such as recreation, water, and esthetics. Outside sources of income for farmers such as nonagricultural employment are not reflected but are of considerable importance to many farmers.

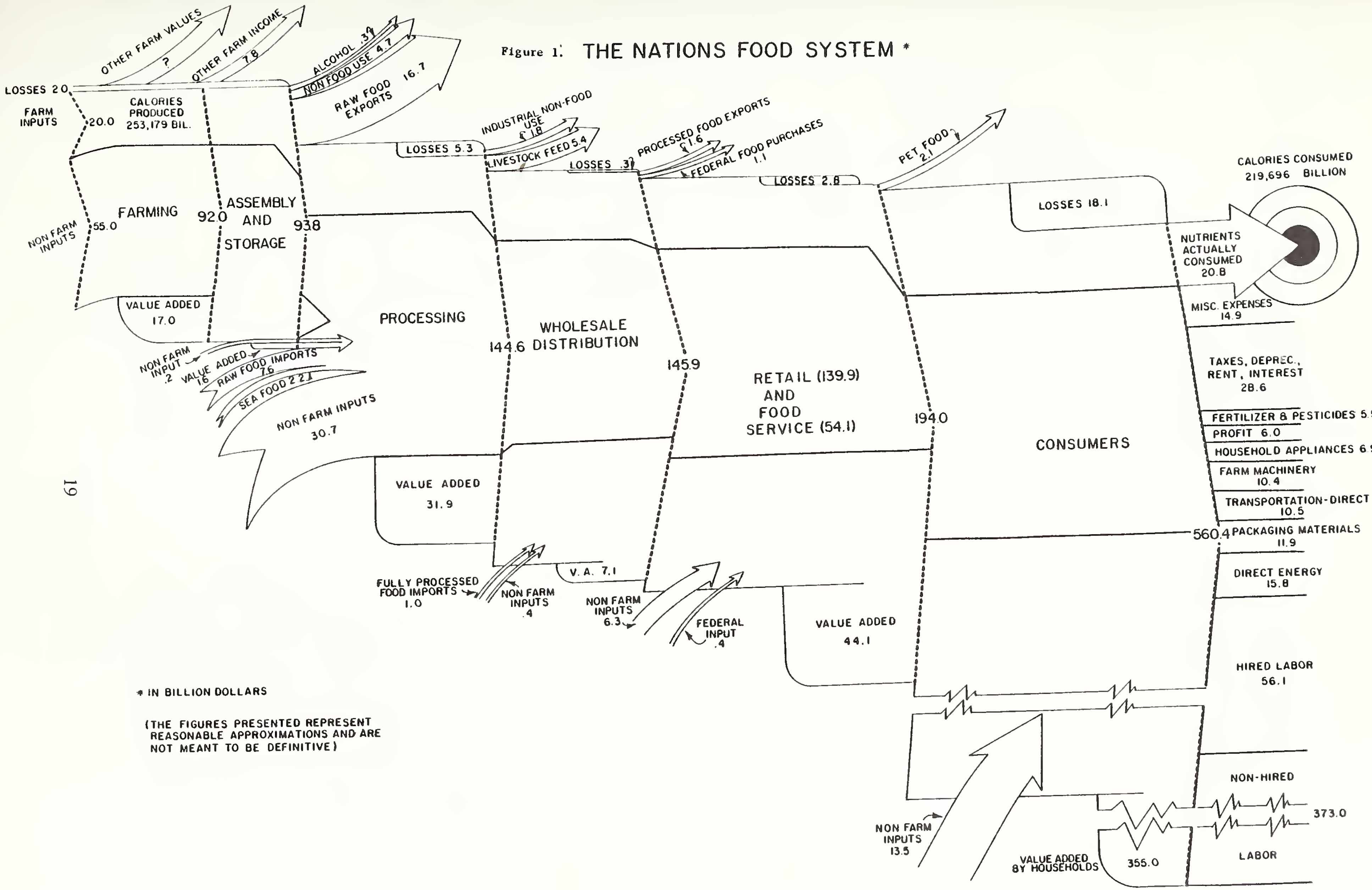
As we move to the right, across the chart, major processing and marketing activities such as assembly and storage, processing, wholesale and retail are shown. These blocks reflect the costs of the function regardless of who performs it and are not based on groups of individual enterprises since such accounting data is often obscured due to vertical integration in ownership of enterprises. Also, assembly, storage, and processing activities occur for some of the $20 billion of farm inputs. These costs are included in the assembly and storage block. Food exports and imports as well as fiber and industrial uses are shown as reductions or additions to the system. The importance of raw food exports to farm income can be seen. Major nonfarm inputs for processing are packaging materials and fuels. Transportation occurs between each segment with the major expense area between processing and wholesaling and is included in the expenses of each segment.

The retail and food service segment delivers about $194 billion of food to the consumer. At this point, we wondered what the value added concept would look like applied to the consumer. We have applied the same concepts at reasonable wage rates to food in the home. Since this consumer input is so large, the chart has been adjusted to make the presentation manageable. Nonfarm inputs for the housewife include food preparation and storage equipment, fuel used in food procurement and preparation, waste disposal, etc. The major item, however, is the labor in food procurement, meal planning and preparation at reasonable wage rates, $355 billion. 2/

1/ Data calculations and sources available on request from author.

2/ Data prepared by Frances M. Magrabi, Group Leader, Family Economics Institute, ARS, Hyattsville, Md.

Figure 1: THE NATIONS FOOD SYSTEM *



* IN BILLION DOLLARS

(THE FIGURES PRESENTED REPRESENT REASONABLE APPROXIMATIONS AND ARE NOT MEANT TO BE DEFINITIVE)

Retailers have been trying to shift expenses to the consumers for a number of years by elimination of delivery, self service, etc. On the other hand, housewives or shoppers have increasing demands on their time for other activities. We think this explains the trade-offs we see such as away from home meals and the "built-in maid services" in ready prepared foods.

The primary point made by this chart is the relative size of the different parts of the system and the importance of nonfarm inputs to the price of food. Farming itself, represents only a very small though vital part of a large system and farm prices and profitability are obviously very much at the mercy of variations in the other larger parts of the system. Without the efficient operation of all parts of this total system, no one part can survive by itself. Therefore research, extension and service activities need to be balanced so we have all parts of the system covered and coordinated. The significance of this to the National Agricultural Library is that information needs are much broader than just for farming and rural subjects.

At the right-hand side of the chart, start at the bottom to subtract from this total figure of $560 billion, the component nonfarm or value added costs. Labor is the largest segment, but energy, transportation, machinery, packaging, and capital costs obviously have a major input on food prices. After these costs are subtracted, there is around $20 billion left which is remarkably close to original farm input.

We also calculated the calories of U.S. farm produced food and the estimated calories consumed by U.S. citizens. The average consumption figure for all men, women, and children is considerably above recommended diets but we are known to consume more than we need. This chart does seem to indicate that we are not losing very many calories in our distribution system. Calories are not the best indicator of nutrition, however, we are unable to make any estimate of nutrient losses in food that occur during marketing. Nutrient loss is undoubtedly a critical area for the United States. Food losses, however, are defined many ways and if we take the best available estimate of dollar losses these are considerable. These figures, incidentally, check fairly well with recent data from the U.K. 3/ We have not included harvest losses which may be quite significant, perhaps as much as 8 to 10 percent. The first figure shown is a $2 billion loss for assembly and storage which is reflected back to the farmer due to the typical commission type sales or quality dockage that occurs. This is a cost typically borne by the farmer.

Processing losses are the least preventable of those shown here and probably represent that part of the product which is uneconomical to recover. When products are assembled in large quantities, the maximum utilization is usually achieved by industry, as is reflected in the statement that "every part of a hog is used except the squeal." Considering the extensive form changes taking place in food processing, a less than four percent loss would seem remarkably low and may indicate that a viable approach to food loss prevention is the concentration of product.

Losses at wholesale are minimum and these include a substantial part of transport losses. Losses at retail are larger and represent some processing activity in the store. Food service losses are included here but only for the back room and food preparation areas. In both of these losses the product is seldom recovered for other uses and there is an additional expense for disposal.

The last loss item in the consumer column is for loss in the home and plate discards for both homes and food service outlets. A substantial portion of this loss is the food left on the plate and discarded after the meal.

We have some reasonably good data from the School Lunch Program and from the USDA Agricultural Research Service (ARS) Consumer and Food Economics research which seems to be well supported by the Arizona garbage studies. 4/ To these food losses there must be added a substantial cost for garbage disposal. All of these losses, which are stated in dollars, include substantial nonfarm inputs and value added as the product moves through the marketing system. These losses represent about a 20 percent product reduction. Even with harvesting losses added, these dollar losses may not represent as major a reduction in the ability to feed people as would occur in a less developed country where 30 percent or more of the food stored on the farm is reported lost to insects, rodents, mold, etc. However, the U.S. loss estimates do represent a substantial potential

(Continued on page 8, col. 2)

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